PATENT

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APPARATUS FOR PROTECTING ELECTRONIC CIRCUITRY

The invention relates to a device for protecting electronic circuitry and/or an attached electric appliance or device against unacceptably high electric energy pulses.

For supplying electric appliances such as telephones and the like with electricity, or for charging their batteries, an electric plug connection normally connects them with an electric power supply or a battery charger. Protective circuitry prevents damage to the appliance from an excessively high voltage or overload, and typically has a regulator, such as a series or shunt regulator with a transistor, a Zener diode, or the like. Such appliances have the drawback that their electronic circuitry can be destroyed when subjected to an unacceptably high voltage, for example because they were used with unsuitable power supplies or battery chargers which might be attached with appropriate adapters.

In view thereof, the present invention seeks to prevent the destruction of protective circuitry by disconnecting the power supply or battery charger when the current or voltage is unacceptably high.

This is accomplished in accordance with the characterizing portion of claim 1.

When the appliance is connected to a power supply or a battery charger which subjects it to an unacceptably high energy supply, the present invention both limits the excess voltage and opens or interrupts the electric circuit if the high energy level causes a heat-up. In this manner the entire appliance is protected.

The protective element is simple. In one preferred embodiment, two spaced-apart solder surface pairs are interposed at at least one point of the electric conductors. One of the solder surfaces is connected with the current supply and the other one with the current consumer. The

protective element extends between and thereby connects the two solder surfaces of each pair. A spring mechanically prestresses the protective element so that, when the solder melts, the element becomes separated from the associated solder surface pair. The spring can be a leaf spring which has at least one shoulder that extends through a slit in the circuit board and presses against the connecting element. It is relatively easy to attach the leaf spring to the circuit board. One of its ends can be positioned in a cutout along the edge of the circuit plate and is provided with lateral extensions that are supported on the circuit plate. The other end of the leaf spring can be provided with a snap lock forming hook that extends through an opening in the circuit plate. To simplify the connections, the conductive lines on the circuit board are provided with solder surfaces for connection to the power supply conductors. Solder surfaces for the diode are arranged side by side and located beneath the connecting points of the diode. For soldering the protective elements, a solder is preferably chosen which has a well-defined melting point that is selected for melting at a predetermined, acceptable temperature. For example, the protective element can be a suppression diode which establishes the predefined voltage value. The current user might be a storage battery or cell which, together with the protective element, is arranged in a housing. The protective element is particularly useful for use with batteries that have at least one Li-Ion-cell.

An example of the invention is shown in the following drawings:

Fig. 1 is an enlarged, longitudinal cross-section of the protective arrangement of the present invention;

Fig. 2 is a plan view of the arrangement shown in Fig. 1;

Fig. 3 is an underneath view of the arrangement shown in Fig. 1; and

Fig. 4 is a side elevational view of the arrangement shown in Fig. 1.

The components of the protective arrangement are mounted on a printed circuit board 1 made of an appropriate synthetic material such as epoxy resin. Circuit board 1 has four current paths 2, 2', 3, 3' which have solder surfaces 4, 4', 5, 5'. Solder surface 4 is for connection to the negative terminal of the power supply or battery charger. Solder surface 4' is for connection to the negative terminal of the electronic appliance circuitry. Correspondingly, solder surfaces 5, 5' are connected to the positive sides of the power supply or battery charger and of the electronic appliance circuitry, respectively. The other ends of current paths 2, 2', 3, 3' have solder surfaces 6, 6', 7, 7'. The surfaces of each pair are spaced apart and positioned beneath connecting points 9, 10 of the protective element, for example a diode 8 which may comprise a suppressor diode. Connecting points 9, 10 of diode 8 are soldered to solder surfaces 6, 6', 7, 7' to enable current flow from current paths 2, 2' and 3, 3' via connecting points 9, 10. The solder for diode 8 is a soft solder that is chosen so that it melts at a preselected temperature.

A spring, in the form of leaf spring 11, forms an important part of the invention and is arranged beneath circuit board 1. Two lateral shoulders 12 extend from a midportion of the spring through slots 13 in circuit plate 1, engage the underside of diode 8, and exert a spring force against it. One end of spring leaf 11 is bent upwardly and extends through an edge cutout of circuit plate 1. That spring end also has two lateral shoulders 15 which engage and are supported by circuit board 1. The other end of spring leaf 11 has a locking hook 16 that extends through an opening 17 in the circuit board 1 and forms a snap lock. The end of the hook is supported on the surface of the circuit board. In this manner, both ends of leaf spring 11 are fixedly attached to circuit board 1 and generate a spring force directed towards the circuit board.

During normal operation, a negligible current flows through diode 8. In the event a wrong connection generates an unacceptably high voltage, the solder at solder surfaces 6,

6', 7, 7' softens and melts. The spring force generated by leaf spring 11 pushes the diode upwardly away from solder surfaces 6, 6', 7, 7', thereby interrupting the current paths and attaining the desired protection of the appliance circuitry.

Parts List

1	circuit plate
2	conductor
2'	conductor
3	conductor
3'	conductor
4	solder surface
4'	solder surface
5	solder surface
5'	solder surface
6	solder surface
6'	solder surface
7	solder surface
7'	solder surface
8	diode (element)
9	connecting point
10	connecting point
11	leaf spring
12	shoulder
13	slot
14	edge cut-out
15	shoulder
16	locking hook
17	opening